A Single Integrated Data Model – It IS for You

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A Little Background

- FHWA regulations require all state DOTs to have similar highway inventory systems
- Route-milepoint systems are universal
- Frequently different and overlapping location referencing systems (LRS)
- What's mine is mine, what's yours is probably useful

Previous GIS-T Papers

- http://www.upa.pdx.edu/CUS/PUBS/contents.html
- Published papers cover theoretical model development and practical application guidelines
- Also in next URISA Journal issue due out this month.

Why an Integrated Model?

- Framework and principles
- An Enterprise GIS-T data model
  - guards against ambiguities
  - provides a basis for framework and principles
- Only the model is integrated, the implementation is not

Application Differences

- Purpose –
  - Vehicle navigation
  - Address geocoding
  - Background /reference layer
- Geographic detail and accuracy
- Content/definitions of features –
  - Private streets, alleys, resource roads
  - Air routes
  - Railroads
  - Pedestrian paths

Current Standards Are Inadequate for Easy Exchange

- Exchange Standards (neutral format)
  - SDTS, DIGEST
- Application Standards
  - TIGER, GDF
- Manual Conversions
  - Geocoding to native LRS

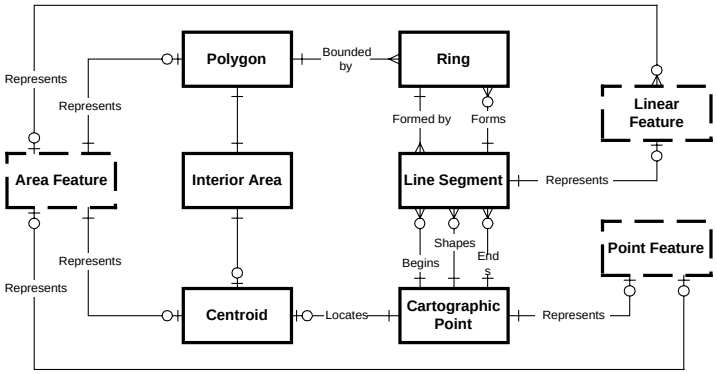
Approaches to Data Sharing

- Top down
  - Matching at the object or feature level
  - Requires LRS
- Bottom up
  - Matching at the geometry level (map conflation approach)
  - Requires x, y, [z] location

Bottom-up Conflation Problem

- The “integrated topological vector model” approach
  - Bundles cartography, network link, and attributes into a single linear spatial object
  - Basic shortcoming of object-oriented approach
- Requires simultaneous resolution of the feature, attributes, topology, and cartography

Topological Vector Model



A Variation on Bottom-up

- Improved location using GPS rather than LRS
- Snapping of accurately located events to accurate representations of roads
- Unproven: All relations can be built on the fly

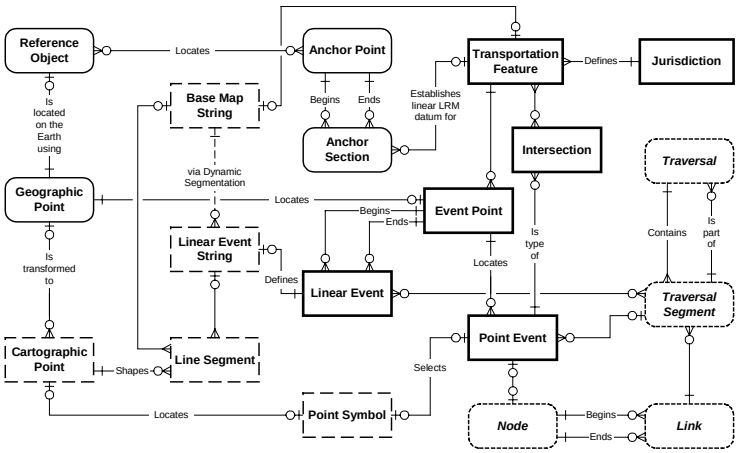
Conflation Issues

- Differences in spatial accuracy
- Differences in content
- Different objects
- Different rules for connectivity
- Different levels of detail

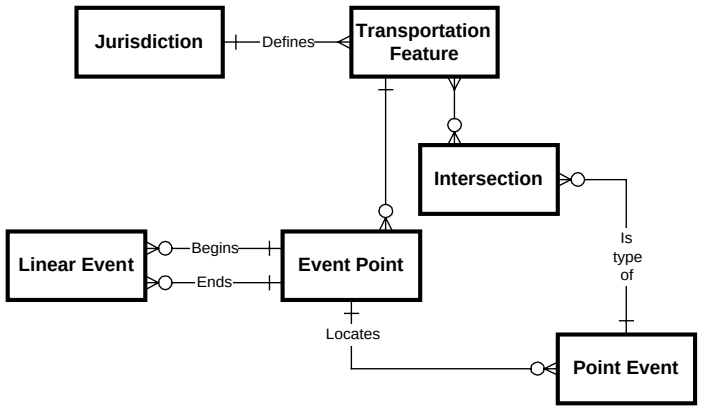
Enterprise GIS-T Data Model

- Transportation Features located within jurisdictions
- Multiple representations
  - Transportation Feature String (of coordinates): Conceptual centerline
  - Transportation Feature String: Physical centerlines (including dual roadways and ramps)
  - Transportation Feature String: Engineering drawings
- Transportation Feature Event Tables

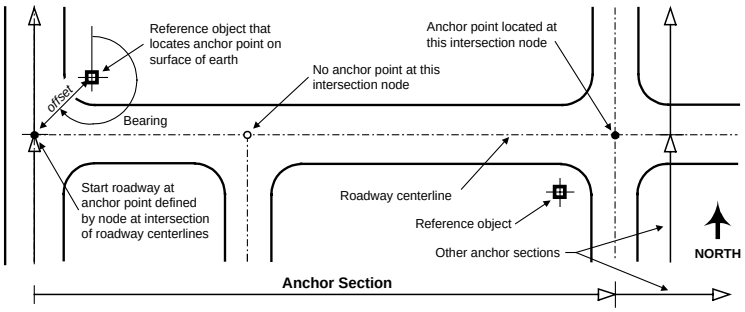
Enterprise GIS-T Data Model for Highways



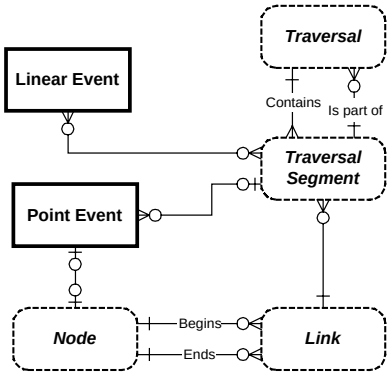
Basic Elements - Highways



LRS Business Rules



Network Elements



Application-specific Networks

- Select feature types
- Identify attributes of interest
  - Lanes, Surface type, Speed limit, Weight and Height Limits, Bus stops, RR company
- Build network w/constraints and attributes
  - From logical centerline strings
  - From navigational centerlines string

Recommendations: Principles

- Establish a schema for Transportation Features and their identifiers
- Develop a common data model that holds the TF as the entity of interest
- Represent TF attributes as linear and point events
- Locate attributes along a TF using linear LRS (others allowed as secondary)

Recommendations: Process

- Exchange relevant TFs and events, not links and nodes of networks
- Enlist state and local agencies to define common TFs
- Update the vectors using GPS-derived data, if available and desired

IMHO: Objects vs. Features

- Integrated feature-based data model is required to exchange data
- Integrated object-oriented data model is contrary to easy data exchange
- Topological vector data model is map-centric and also hampers data exchange

IMHO: Temporal Elements

- Time is a secondary LRS
- Time stamps may include
  - Local time
  - Universal time
  - Duration

IMHO: GPS Applications

- Can be useful for cartographic object construction
- Should be secondary to LRS location
- Measurement may not be at proper location
- Good for getting you close on a map

IMHO: Data Modeling

- Object-oriented (OO) model approaches (e.g., UML) are good at representing real world
- Entity-relationship (ER) models can be more directly implemented as database designs
- OO models should be expressed as ER models prior to implementation

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